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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
SUBTROPICAL TEXAS AREA
SCREWORM RESEARCH LABORATORY

MISSION, TEXAS

FOURTH QUARTERLY REPORT, 1974

SCREWORM BIOLOGY AND CONTROL

THIS PROGRESS REPORT INCLUDES TENTATIVE RESULTS OF RESEARCH NOT SUFFICIENTLY COMPLETE TO JUSTIFY GENERAL RELEASE. SUCH FINDINGS, WHEN ADEQUATELY CONFIRMED, WILL BE RELEASED PROMPTLY THROUGH ESTABLISHED CHANNELS. THEREFORE, THIS REPORT IS NOT INTENDED FOR PUBLICATION AND SHOULD NOT BE REFERRED TO IN LITERATURE CITATIONS.

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NEW STRAINS
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NEW STRAINS

Development.

(M. M. Crystal, J. J. Garcia, A. Fuentes)

Texas Strain (FF8).

Collections of screwworms were received by the Screwworm Research Laboratory (SRL) from 25 different locations in three Texas counties south of Kingsville. Each of the 15 collections from Brooks County, 8 from Jim Hogg County, and 2 from Hidalgo County was reared separately. The collections were mass-intermated two at a time by reciprocal crosses, and the F_1 pupae of the two crosses were mixed. This process was continued until all the hybrids had been combined into a single Texas strain designated by the code FF8.

Northern Mexico Strain (MM7).

Collections of screwworms were received by SRL from 55 different locations in 4 Mexican states north of Tampico. Each of the 11 collections from Tamaulipas, 6 from Coahuila, 14 from Durango and 24 from Sonora was reared separately. The collections within a state were mass-intermated two at a time by reciprocal crosses, and the F_1 pupae of the two crosses were mixed. This process was continued until all the hybrids from one state had been combined into a single substrain designated by the codes BB3 for Tamaulipas, DD2 for Coahuila, HH8 for Durango, and LL9 for Sonora. Then these were mass-intermated two substrains at a time by reciprocal crosses until all were combined into a single Northern Mexico strain designated by the code MM7.

Laboratory Evaluation

(M. M. Crystal and Roberto Ramirez)

The laboratory evaluation of the quality of screwworm strains for mass-production, irradiation, and release routinely includes the assessment of longevity, sexual aggressiveness, mating capacity, and mating competitiveness. The Florida strain is used as a standard of comparison. The tests are replicated three times on different dates.

For longevity, 50 each of unirradiated or irradiated newly emerged flies of one sex are placed in duplicate cages. Dead flies are removed from all cages daily, and the number of each sex surviving is recorded until there are no survivors. The median lethal time (LT_{50}) is the middle value used to compare different strains.

For sexual aggressiveness, duplicate cages contain 75 males and 25 females 5 days old. The males are unirradiated or irradiated and come from the new strain or the reference strain. The females are always of the reference Florida strain. Mortality of the females is recorded daily, and the effect is determined of the accelerated female mortality owing to harassment of the males.

In tests for mating capacity, duplicate cages of 5-day-old flies contain 5 males and 100 Florida females. Egg masses are obtained 48 hours later, and the number of masses which hatch are determined. The percentage of females inseminated by the males is then calculated.

For mating competitiveness, duplicate cages of 5-day-old flies contain 15 fertile or sterile test males and 15 sterile or fertile (opposite that of the test strain) Florida males and 75 fertile Florida

females. Other cages contain 30 males and 75 females, all fertile, of the Florida strain. Oviposition and egg hatch are determined as for mating capacity.

During FY 74, the laboratory evaluation was completed for one strain (D7) developed earlier and begun for the strains developed more recently.

Texas-Mexico Strain (D7).

All tests with D7 were conducted with F₁₋₁₀ flies. D7 males survived better than Florida males, and D7 females survived as well as Florida females, whether the flies were unirradiated or irradiated. Unirradiated or irradiated D7 males harassed Florida females less than Florida males did. D7 males and Florida males inseminated Florida females equally. Fertile D7 males were more competitive than sterile Florida males, but sterile D7 males were less competitive than fertile Florida males.

Texas-Strain (FF8).

Only the test for mating competitiveness has been completed at this writing. The results were as follows:

<u>FF8 Males</u>	<u>No. egg masses with hatch</u>	
	<u>Expected</u>	<u>Observed</u>
Fertile	187.	74
Sterile	185	354

Coahuilla Substrain (DD2).

Only the test for mating competitiveness has been completed at this writing. The results were as follows:

DD2 DD2 Males	<u>No. egg masses with hatch</u>	
	<u>Expected</u>	<u>Observed</u>
Fertile	189	19
Sterile	187	373

Thus, DD2 males (F_{3-5}) were almost not competitive with Florida males for Florida females.

COLD TOLERANCE OF ADULT SCREWORMS

M. M. Crystal and Roberto Ramirez

Newly emerged TX strain screwworm flies were held 8, 16, 24, or 48 hours at 10°C or 16°C and then placed at 27°C. Other flies were held continuously at 27°C. For each exposure, there were duplicate cages of 50 flies of mixed sexes that had been irradiated as pupae with the standard dose. Dead flies were removed from all cages daily, and the number surviving was recorded until there were no survivors.

In other duplicate cages, test males were combined with 25 irradiated and unchilled females when all flies were 5 days old to test the effects of chilling on mating competitiveness. There were

25 unchilled or chilled irradiated males or 25 unchilled unirradiated males or 25 chilled or unchilled irradiated plus 25 unchilled unirradiated males. Egg masses were obtained 48 hours later from each female and pooled for each cage. The eggs were separated in 1% sodium hydroxide solution, and about 100 eggs from the females of each cage were transferred to moist filter paper in each of two petri dishes. The percent hatch was calculated from the pre-and posthatch tallies after overnight incubation at 37°C.

The test at 10°C was conducted with F₁₁ generation flies and was unreplicated. The test at 16°C was conducted with F₁₂₋₂₀ generation flies and was replicated three times on different dates. Results were as follows:

Exposure (hr)	LT ₅₀ (days)		% hatch	
	10° (27°)	16° (27°)	10° (27°)	16° (27°)
8	11.9 (12.1)	14.9 (14.5)	43 (42)	48 (29)
16	16.3 (13.8)	18.0 (17.6)	72 (32)	47 (57)
24	14.4 (19.7)	14.6 (13.1)	62 (60)	37 (39)
48	14.9 (10.4)	15.2 (12.5)	51 (61)	29 (48)

Except for the aberrant results at 24 hours, flies exposed to 10°C lived as long or longer than unchilled flies. At 16°C, chilled flies lived longer than unchilled flies, and the LT₅₀ increased as the exposure was increased. At all intervals at both reduced test

temperatures, chilled irradiated males were mostly equally competitive or more competitive than unchilled unirradiated males. Thus chilling at 10° or 16° for 8 to 48 hours apparently did not reduce longevity or mating competitiveness.

LABORATORY FLIGHT OF SCREWORMS

M. M. Crystal

Flight ability, as an expression of the vigor of screwworms, is being evaluated as a measure of the quality of flies to be selected, mass-reared, and irradiated for release. SRL obtained by transfer from the Department of Defense a flight mill system that we adapted for screwworms. The system includes a device that insures uniform orientation of screwworms tethered to flight mill arms. Data recording equipment accurately measures the distance flown, the flight duration, and the speed of flight.

Four 5-day-old F_6 males of strain D4 (interbred from one collection each from Hidalgo, Goliad, and Nueces Counties) were observed on the flight mills for one hour. An acceptable flight is arbitrarily set at a minimum duration of two minutes and the minimum distance of 160 meters. During the one-hour period, they flew on the average 2,663 meters in 45 minutes at a speed of 3,294 meters per hour.

Males of different ages of a laboratory strain and the production strain were observed on the flight mills for two hours. The results were as follows:

<u>Age (days)</u>	<u>No. flies</u>	<u>Time in flight (min)</u>	<u>Distance flown (m)</u>	<u>Sustained speed (m/hr)</u>
-----------------------	----------------------	---------------------------------	-------------------------------	-----------------------------------

SRL strain D7 (Texas-Mexico)

<1	4	8	66	495
1-2	2	<72	1060	<883
2-3	3	68	2554	2253
3-4	2	48	1601	2001
6-7	2	119	5413	2729
7-8	2	25	133	319

Production strain (APHIS)

<1	1	22	1105	3014
1-2	3	<74	2955	<2396
2-3	5	40	941	1411
3-4	2	79	3294	2501
6-7	2	32	1086	2036
7-8	2	68	911	803

In both strains, males less than one day old flew less than 10% of the time. Older flies flew mostly about 25% of the time. Males of both strains flew shorter distances when they were less than one day old and longer distances thereafter up to one week of age after which the distances flown decreased. D7 and APHIS males less than one day old flew at low and high speeds, respectively. Between one

and seven days of age, males of both strains flew at an average of about 2,000 meters per hour. Then after 7 days, they flew at reduced speeds. In general, males of both strains flew about as long, but APHIS males surpassed D7 males in distance flown and in speed of flight.

Data are now being collected for the flight characteristics of Florida strain flies. Sufficient data have been collected for 1- to 17-day-old males and 1- to 11-day-old females. Additional data are being obtained for older flies. Study and analysis of the data will reveal the presence of differences, if any, among ages and between sexes that are not due to chance.

Future studies are planned to test other strains, to compare their performance with respect to duration of flight and utilization of energy, to determine the influence of age, irradiation, and other factors on their comparative flight abilities. The determination of the wingbeat frequency with a stroboscope will provide another measure of the comparative flight ability of different strains. Colonization, irradiation, and strain differences may affect the propensity of screwworms to fly. Preliminary testing has revealed that among mature flies, females appear to have a greater inherent tendency than males to fly.

CHEMICAL ATTRACTANTS

Calvin M. Jones

Significant progress in developing a chemical attractant for use in trapping screwworm adults was made by Dr. Rolland Grabbe prior to his resignation from this laboratory's staff in October 1973. He found that mixtures of 36 chemicals selected as being break-down products of animal tissue were attractive to screwworm flies and attracted a higher percentage of males than did liver. His preparations were not highly attractive, and freshly prepared bait was effective for one day or less. This research was dormant until February 1974.

One of the recommendations resulting from the Executive Conference, held to review the work and needs of the screwworm research program in February 1974, was to continue the search for a chemical attractant. Mr. Delbert Oehler, Chemist, ARS, USDA, College Station, Texas, agreed to give technical advice in the selection and use of chemicals. After reviewing Dr. Grabbe's work, he reduced the list of 36 chemicals to 29 and added another and suggested a beginning formulation for outdoor trapping studies. He suggested 3 groups based on compatibility (Table 1).

Outdoor trapping studies were begun February 11. Mr. Oehler has continued to furnish guidance on grouping of chemicals, concentrations and formulations as data are gathered.

The first baits (the preparations^{are} put in the pans beneath the standard fly trap) consisted of 10 microl. (or micrograms of those in the solid state) of each of the 30 chemicals in 10 ml glycerine. At first chemicals 1-24 were mixed and formulated as one group. After about 3 weeks, this group was divided: 1-10 and 11-24. The remaining 6 (25-30), all amines, were mixed and exposed as a separate group. Traps were baited with one, two, or all three of the groups. They were mixed together or put separately in shallow dishes and with or without the addition of water to the glycerine mixtures. At the rate of 10 microl. of each chemical per trap, group 1 (1-10) was slightly attractive, group 2 (11-24) was more attractive, and group 3 (25-30) was almost nonattractive. Attempts were unsuccessful to increase or prolong attractiveness beyond 2-3 days by placing glycerine mixtures in test tubes (open or stoppered and vented with a 18-ga needle to exclude light and air) or by using a string to wick the mixture out of the container.

After 3 weeks of testing with the 10 microl. rate, the concentration was increased to 500 microl. per trap bait. Until the present time, this rate has been near optimum for the delineation of effective chemicals, formulations, and methods of exposure.

Since March 1, more than 100 treatments (some repeated several times, each of them with 2 or 3 replications and conducted for periods of 1 to 12 days) have been tested. Except during one 11-day test period, from 2 to 3 traps baited with bovine liver have been in

others are repellent, at least when equal amounts of each are used.

The chemicals in group 3 have not been checked individually, but omission of the entire group improves the catches.

4. It is also apparent that a more efficient trap could be designed, one that results in the fly being captured on its first approach. The flies attracted to the chemical baits seem to be more excited and less prone to work their way into the cone of the trap.

Finite data for developing a bait using a large number of chemicals with vapor pressures ranging from 1323 to 0.0127 are extremely difficult to obtain under field conditions. There is great optimism, however, that a bait better than liver can be developed.

Most of the tests using rates of 500 microl. (more or less) and ethanol as a diluent for dispersing are summarized in Table 2.

TABLE 1. Chemicals screened for attractiveness to screwworm flies.

		A,B	1	2	3	4	5	6	7	8	9	10	11
<u>Group 1</u>													
1	ACETIC ACID	A1	X	X	X		X	X					
2	BENZOIC ACID	A2	X	X	X	X		X	X				
3	BUTANOIC ACID	A3	X	X	X	X		X	X				
4	LACTIC ACID	A4	X	X	X	X		X	X				
5	HEXANOIC ACID	A5	X	X	X		X	X	X				
6	OCTANOIC ACID	A6	X	X	X		X	X	X				
7	PENTANOIC ACID	A7	X	X	X		X	X	X				
8	PROPANOIC ACID	A8	X	X	X		X	X	X				
9	ACETALDEHYDE	A9	X					X					
10	FORMALDEHYDE	A10	X						X				
<u>Group 2</u>													
11	INDOLE	B1	X	X				X		X	X	X	X
12	SKATOLE	B2	X	X				X		X	X	X	X
13	PHENOL	B3	X	X				X		X	X	X	X
14	p-CRESOL	B4	X			X		X		X	X	X	X
15	PYRIDINE	B5	X	X					X	X	X	X	X
16	BUTANOL	B9	X		X					X			
17	iso-BUTANOL	B10	X		X					X			
18	sec-BUTANOL	B11	X		X					X			
19	ACETONE	B6	X				X		X	X		X	X
20	METHANOL	B7	X				X		X	X			X
21	ETHANOL	B8	X				X		X	X			
22	2-BUTANONE	B12	X		X					X			
23	DIMETHYL SULFIDE	B13	X		X								
24	ETHANETHIOL	B14	X		X								

TABLE 1. Continued

Group 3

25	1,5-DIAMINOPENTANE
26	ETHANOLAMINE
27	ETHYLAMINE
28	METHYLAMINE
29	iso-PROPYLAMINE
30	TIRMETHYLAMINE

Classification of compounds:

1-10	2 aldehydes 8 acids
11-24	alcohols ketones cyclic amines sulfides etc.
25-30	amines

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
RADIOLOGICAL SAFETY STAFF
AGRICULTURAL RESEARCH CENTER
BELTSVILLE, MARYLAND 20705

EAT *WFS*
WFS *WFS*
JE *WFS*
NC *WFS*

March 13, 1975

Subject: Dose Rate Variation in Human Irradiators

To: J. Wendell Snow
USDA, ARS, Screwworm Research Laboratory
P.O. Box 986
Mission, Texas 78572

Reference your letter dated February 26, 1975.

The calibration data for the prototype Human irradiator Model 520, Serial Number H-001 was sent to you earlier. Data sheet numbers one and three clearly show the type of dose rate variation in that unit. Note that the low areas occur at the extreme ends of the canister. Note also that the center cross section is less than 10 percent higher than the ends. The high dosage areas occur approximately midway between both ends and the center section of the cannister.

The type of variation in this unit makes elimination of any specific area very difficult. You could block off about 1 inch in each end. However, this would only reduce the high dosage 7-8 percent with about a 11 percent loss in volume. Any further blockage on the ends would require blocking of the center also. It is doubtful that any type of blockage in the high dosage area could achieve much greater reduction than 10-15 percent with much greater loss in volume.

Perhaps one good possibility for decreasing dosage would be to make a reduction in irradiation time with no other changes. The irradiation time was arrived at by taking the lowest value found with the cannister loaded with pupae and calculating a time that would assure 5000 R at that spot with a 20 percent safety factor added to take care of the various uncertainties. Perhaps all or part of the safety factor could be eliminated. Of course, this would have to be the decision of program officials and certainly would have to be thoroughly checked by bioassay.

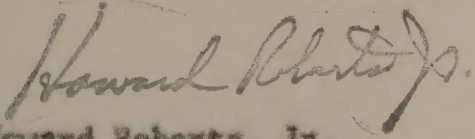
The new irradiators Model 521 serial numbers M-001, M-002 and M-003 have a radiation variation that is quite different from the prototype. The spread between the high and low points is greater, however, the center cross section does not drop off nearly as much. Therefore, the ends of the cannister could be blocked rather easily. Blocking two (2) inches off of each end would reduce volume by about 22 percent with about a 20 percent increase in irradiation time.

RECEIVED

MAR 17 1975

AREA OFFICE
WESLACO, TEXAS

If you have further questions, please contact us.

A handwritten signature in dark ink, appearing to read "Howard Roberts, Jr.", with a stylized flourish at the end.

Howard Roberts, Jr.
Assistant Radiological Safety Officer

cc: Dr. Gartman
Dr. Williams
Dr. Meadows
~~Mr.~~ Taylor
Dr. Crystal

SUBTROPICAL TEXAS AREA
P. O. Box 267
Weslaco, Texas 78996

March 26, 1975

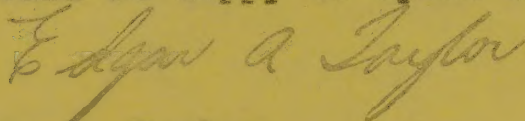
Subject: Dose Rate Variation in Husman Irradiators

To: J. Wendell Snow, Research Leader
Screwworm Research, ARS-USDA
Mission, Texas 78572

Reference is made to your letter of February 26th to Howard Roberts concerning the high radiation dosage and variation in the above Cs 137 unit and his reply of March 13th. I was not aware that the new irradiator had a 40 percent variation in dosage, nor that a 20 percent "safety factor" was added. This means all insects receive an overdose of radiation ranging from 20-60 percent. This must be doing considerable damage to the competitiveness of the flies.

I suggest you talk with M. E. Meadows about this problem. I don't know what can be done, but surely laboratory and field data exist on the effects of radiation on fly activity and competitiveness. If data are not available, I urge you to give this matter high priority in your research program.

If I can be of any help, please let me know. If useful, I will be happy to spend some time at Moore Field.



E. A. Taylor
Area Director

CC:

S. C. Gartman
D. Williams
M. E. Meadows
L. S. Henderson
H C Cox
M. M. Crystal

ARS:SR:STA:EATaylor:je 3/26/75

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE

SOUTHERN REGION
SUBTROPICAL TEXAS AREA
P. O. Box 986
Mission, Texas 78572

March 27, 1975

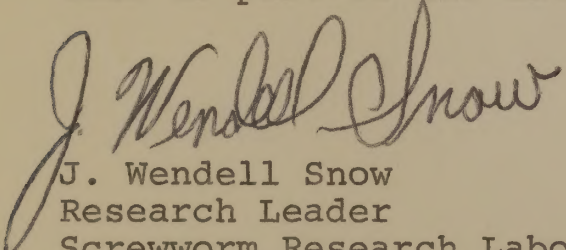
Subject: Dose Rate Variation in Human Irradiators

To: E. A. Taylor, Area Director
Subtropical Texas Area
Weslaco, Texas 78596

I agree with your concern over the excessive radiation treatment of screwworm flies. This is the reason a Cs 137 unit was obtained from Byron, Georgia and M. M. Crystal's research assignment altered to cover this area. Little laboratory or field data exist to show the effects of radiation on competitiveness. However, M. M. Crystal is currently conducting a series of laboratory tests using factory pupae treated 24 hours before emergence. In addition, I will ask him to initiate field tests to determine the effects of various levels of radiation on field activity and movement of flies. I believe we can come up with the labor and funds necessary to support the work.

The best approach now may be to modify the treatment container. This could eliminate about 20 percent of the variation with only a small loss in treatment volume. (Most variation is from wall to wall.) The treatment time would need to be adjusted and this would offset loss in volume.

The 5000 rad dosage must be researched more before we can recommend this as the minimum dose. Treated females produce a few eggs at this rate and we need to conclusively determine that these few hatching larvae are not producing normal adults. This is part of the data M. M. Crystal will develop.


J. Wendell Snow
Research Leader
Screwworm Research Laboratory

cc:
S. C. Gartman
D. Williams
M. E. Meadows
L. S. Henderson
H C Cox
M. M. Crystal

RECEIVED

MAR 28 1975

AREA OFFICE
WESLACO, TEXAS

Sent via telecopier New Orleans

4/28/75 nc
U.S. DEPARTMENT OF AGRICULTURE

DATE

REFERENCE SLIP

4/28/75

TO

A. W. Cooper

H C Cox

L. S. Henderson

☐ ACTION

☐ NOTE AND RETURN

☐ APPROVAL

☐ PER PHONE CALL

☐ AS REQUESTED

☐ RECOMMENDATION

☐ FOR COMMENT

☐ REPLY FOR SIGNATURE OF

☒ FOR INFORMATION

☐ RETURNED

☐ INITIALS

☐ SEE ME

☐ NOTE AND FILE

☐ YOUR SIGNATURE

REMARKS

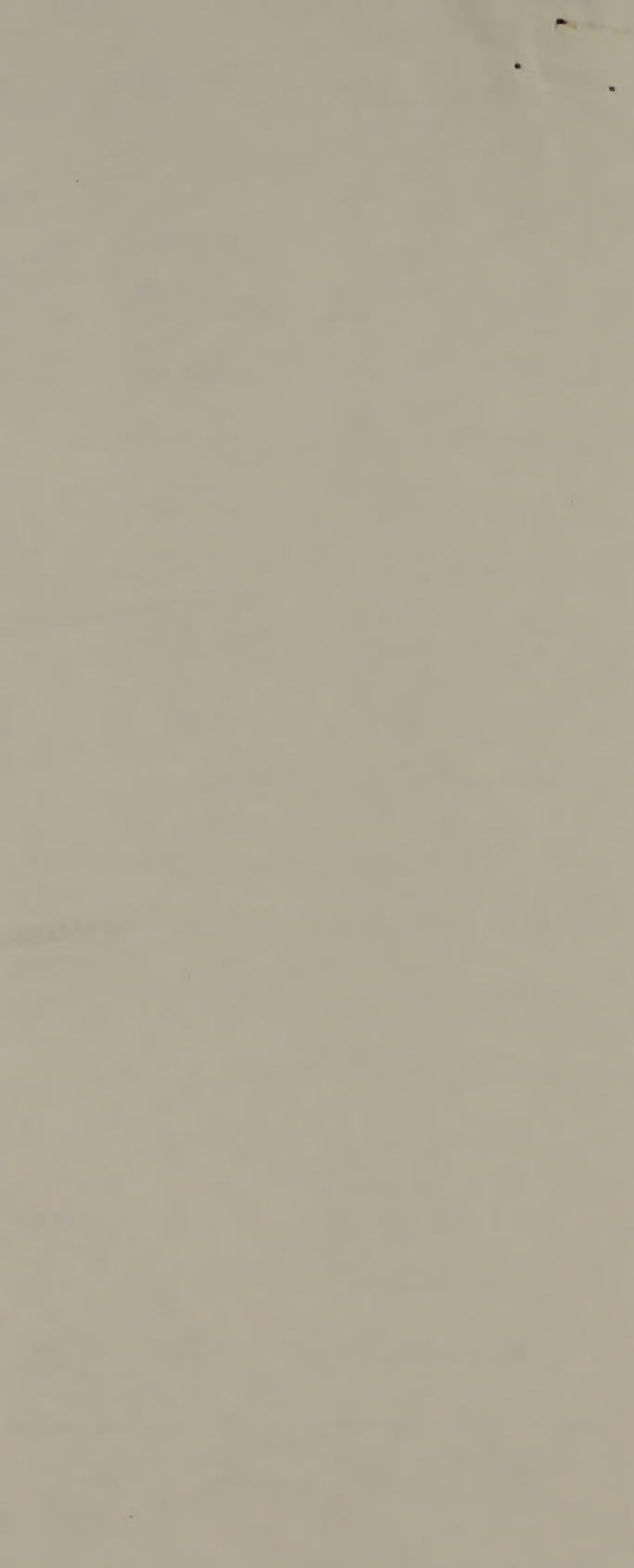
Attention: V. R. Bourdette

Excellent report for Agricultural
Research. For further information
contact J. W. Snow.

FROM

Edgar A Taylor

*Copy mailed
4/29/75
HWC: HCC
LSH: VRB
me*



ID Document	1266
Form 1	Report
Form 2	
Title	Breakthrough in Screwworm Field Research (Screwwor
# of Pages	5 2
Year	1975
Month	April
Day	4
Color?	☐
Spanish?	☐
Subject line	
Subject heading 1	screwworm mating
Subject heading 2	wounded animal
Subject heading 3	flowering vegetation
Subject heading 4	
Description Note	
Author Info	Guillot
Additional Authors	
Recipient	
Sub-collection	Edward F. Knipling Papers
Treatment intent	
Temp CD folder	123
To be scanned?	☐
Scanning completed?	☐
To be re-keyed?	☐
Re-keying completed	☐

4/25/75

Breakthrough in Screwworm Field Research
(SCREWORM MATING BEHAVIOR FIELD OBSERVATIONS *ed on flowering*
in field plants)
by

Frank S. Guillot ✓

initial
Dr. Bushland stated, in his Founder's Memorial Lecture presented at the 1974 ESA Annual Meeting, that virtually nothing is known about screwworm mating behavior in nature. The number of questions asked about screwworm mating in nature can be summarized by the following one: What are the conditions which bring a male and receptive female together for the purpose of mating? Attempts in the laboratory have thus far failed to demonstrate the presence of an attractant in either sex of the adult screwworm. We, therefore, decided to investigate the possibility that the sexes are attracted to a mutual site where, then, mating occurs. We considered two of perhaps many possibilities:

1) a wounded animal, and 2) flowering vegetation.

A series of experiments were begun in the fall of 1974, discontinued with the colder weather, and continued in the spring of 1975. The results, thus far, indicate that a wound, or ovipositional site, is not where mating occurs. In the fall test, 71% of the sterile females attracted to a wound were mated. More significant, however, was that only 5% of the flies were males. Ten viable females were also caught and all ten were mated. The spring collections verify these results of last fall's tests. Ninety-eight per cent of the sterile

✓ Entomologist, at mission Texas working under
ARS - Texas A.M. Cooperative no. 12-14-7001-382
uninitiated (give date) 8/16/74

females were mated and only one of 200 flies were males. Three viable females were caught this spring and all three were mated. An implication of these results is that mating activity has already occurred by the time females respond to a wound for oviposition. However, one limitation is that we do not know the age of the individual flies. It is possible that the flies are older females that mated previously at a wound site. Therefore, more conclusive evidence should include information about the age structure of the population being sampled.

Some information about the minimum age of the population can be obtained by the amount of pupal fat body remaining in the adult. Laboratory studies of other scientists have shown that most mating occurs when the females are three days old. We have observed that the pupal fat body, carried over into the adult stage, is completely utilized by this time and is replaced by the adult fat body. The few virgins responding to the wound still contain some pupal fat body. Most of the flies responding to the wound are, therefore, at least three days of age and are mated. Where, then, are the flies during their first three days?

One possible answer to this question was found this spring. We took advantage of the large number of sterile flies inadvertently released at the mass rearing facility when they are packaged for aerial release. There are several species of wild brush on and around Moore Air Base which were in bloom in late February through early April. This brush was examined for the presence of flies, and large numbers of them were found feeding on the flowers and mating. Males were seen striking out at

other flies (The sex could not always be determined.) on the wing or while they were feeding or resting on a leaf or limb. The pair would usually wrestle about, sometimes take off in flight with the male holding on to the female's dorsum, or sometimes fall to the ground. On several occasions, copulating pairs were seen on limbs, leaves and flowers. Now that flowering is complete, only a few flies are seen frequenting these very same bushes.

It is obvious that these flowering bushes were attractive to the sterile screwworm fly and that they served as a feeding and mating site for the fly. Whether or not flowering vegetation serves the same purpose in open brush country where screwworm flies exist in much smaller numbers is not yet determined. It is interesting to speculate that the increase in the number of cases during very rainy seasons is associated with the increase in possible breeding sites in a more lush vegetation.

4

To: M.T. OUYE (PAC) AND L. HENDERSON (NPS)
CURRENT MISSION RESEARCH STATUS AND REQUIRED CHANGES TO MEET RESEARCH
NEEDS FOR THE EXPANDED SCREWORM ERADICATION PROGRAM

E. A. Taylor
Westaco,
TX

History of Program

From 1962 to 1971 (with a minor exception in 1968), the screwworm eradication program successfully controlled screwworms in the United States. During this time, the ARS Research Laboratory was established (1963) at Mission with a budget of \$200,000/year. However, support was allocated through the Kerrville Laboratory and passed to Mission based on numbers of SMY's rather than appropriated funds. During this period, professionals transferred or retired without replacement. From a maximum of 6 staff members in 1963, only 3 remained committed to screwworm research by 1972.

During 1972, the program suffered a serious setback in the southwestern states. A total of 96,625 cases were reported in Texas alone. There were undoubtedly more unreported cases. During this year, the United States signed an agreement with Mexico to extend the eradication program to the Isthmus of Tehuantepec.

During 1973, the situation was again serious in South Texas. Some ranchers reported as much as 30% loss of herds. Effective control was not obtained until late in the season. This outbreak was related to high populations of the Gulf Coast Tick that provided large numbers of wounds. In 1974 the situation through June indicates another bad year. Infestations are currently 3 times greater than 1973 and range throughout most of Texas. Gulf Coast Ticks are becoming common in South Texas.

Therefore, it becomes apparent that the screwworm program has been extended to include Mexico at a time when results suggest that serious problems exist in our current program. The Agricultural Research Service recognized this after the 1972 outbreak and began restaffing the laboratory and transferring support funds. Currently, 5 SMY's are at Mission with a chemist on loan from Food Crops Utilization Research, Weslaco, Texas. The current approved budget for FY 75 is \$291,700 at project level. The additions have been made through reallocation of existing personnel and funds. The APHIS budget for Mexico and the United States will range from 16 to 20 million/year. Based on current problems and the expanded program, ARS will not be able to adequately meet the research needs of the APHIS program. A proposal is currently before Congress to increase the Mission budget by \$202,000/year (appropriation level) and provide 3 additional SMY's.

Potential Causes of Reduced Program Effectiveness

The highest research priority is the identification of the factors involved in the recent ineffectiveness of release flies. Candidate reasons are:

1. Nutrition. The factory converted to a hydroponic diet shortly before the first outbreak in 1972. This diet has been used intermittently since that time. Sufficient data are not available to establish this medium as a good substitute for meat.

2. Assortive Mating. The selection of an avoidance or recognition mechanism by wild flies over the last 12 years (resistance).

Therefore, it becomes apparent that the screening program has been extended to include Mexico at a time when results suggest that serious problems exist in our current program. The Agricultural Research Service recognized this after the 1972 outbreak and began re-evaluating the laboratory and transferring support funds. Currently, 3 BMY's are at Mission with a chemist on loan from Food Crops Utilization Research, Weslaco, Texas. The current approved budget for FY 73 is \$291,700 at project level. The additional have been made through reallocation of existing personnel and funds. The APHIS budget for Mexico and the United States will range from 15 to 10 million/year. Based on current problems and the expanded program, ARS will not be able to adequately meet the research needs of the APHIS program. A proposal is currently before Congress to increase the Mission budget by \$101,000/year (appropriation level) and provide 3 additional BMY's.

Potential Causes of Reduced Program Effectiveness

The highest research priority is the identification of the factors involved in the recent ineffectiveness of release trials. Candidate reasons are:

1. Attrition. The factory converted to a hydroponic diet shortly before the first outbreak in 1972. This diet has been used intermittently since that time. Sufficient data are not available to establish this medium as a good substitute for meat.
2. Aggressive Hiding. The selection of an avoidance or recognition mechanism by wild flies over the last 12 years (resistance).

3. Behavioral Isolation. Undetected changes in rearing and handling procedures that resulted in alteration of behavior sufficient to isolate the released population (preferential mating of factory x factory flies).

4. Laboratory Adaptation of Strains. Factory strains may lose the ability to compete in the field through natural selection in the process of becoming adapted to factory production.

5. Remating. Factory males may no longer be able to satisfy the wild females in copulation. Equally possible is the selection of wild fly populations that accept multiple mating.

6. Ticks. Increase screwworm cases resulting from an increase in number of wounds caused by the Gulf Coast Tick.

7. Quality Control. Inadequate control of quality in the rearing, packaging, or distribution phase that results in the release of non-competitive insects.

8. Weather. Favorable weather which results in excessive survival of screwworm populations during the winter months.

9. Changes in Practices. Ranchers have changed their practices with the result that cattle population has increased, calving is uncontrolled, cowboys are not used in sufficient numbers to monitor the herds, etc.

While we must investigate all the above factors, our commitment for new research and improved procedures continues. Population detection methods are desperately needed for survey and evaluation. Additional control components are needed as the program moves into Mexico. The Mexico program demands more ecological data regarding distribution,

3. Behavioral Isolation. Undetected changes in testing and handling procedures that resulted in alteration of behavior sufficient to isolate the released population (preferential mating of factory x factory flies).

4. Laboratory Adaptation of Strains. Factory strains may lose the ability to compete in the field through natural selection in the process of becoming adapted to factory production.

5. Releasing. Factory males may no longer be able to satisfy the wild females in copulation. Equally possible is the selection of wild fly populations that accept multiple mating.

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abundance and overwintering. Strong possibilities exist that biotypes of the species occur in the diverse terrain of Mexico.

Current SMY's at Mission

Research Leader (J. Wendell Snow). Coordinates research and cooperative agreements (Texas A&M, University of Texas, INIA, Monterrey Tech) into the screwworm eradication program with both APHIS and the Joint Screwworm Commission. In addition, original research will be conducted by the Research Leader in the areas of ecology, attraction, and competitiveness.

Ecologist ^{1/} (Billie G. Hightower--to transfer in August). Provides field research on the species in diverse Mexican locations. All the varied factors encountered in production and distribution of 200 million sterile flies per week, plus an additional 300 million weekly when the plant in Mexico is activated, must be recognized and evaluated. Behavior of wild flies in canyons and mountain saddles is of particular importance. The existence of biotypes or even distinct species in Mexico must be determined.

Radiation. (Maxwell M. Crystal). The effect of radiation on competitiveness and development of improved methods of sterilization are of principal importance. Radiation effect on competitiveness is a candidate cause of current program problems. Chemical marker techniques such as Calco Red, Rubidium, etc., that are compatible with factory production should be developed. Currently the factory and wild flies cannot be effectively

^{1/} High priority position--needs to be filled desperately.

abundance and overwintering. Strong possibilities exist that biotypes

of the species occur in the diverse terrain of Mexico.

Current SMX's at Mission

Research Leader (J. Wendell Snow). Coordinates research and cooperative

agreements (Texas A&M, University of Texas, INIA, Monterey Tech) into the

extensive eradication program with both APHIS and the Joint Stereotype

Commission. In addition, original research will be conducted by the Research

Leader in the areas of ecology, attraction, and competitiveness.

Biologist (Billie G. Hightower--to transfer in August). Provides

field research on the species in diverse Mexican localities. All the varied

factors encountered in production and distribution of 300 million sterile

flies per week, plus an additional 300 million weekly when the plant in

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High priority position--needs to be filled desperately.

separated. In addition, physiological studies involving digestion, and enzyme systems are needed to support nutritional studies and develop standard laboratory evaluation systems for performance.

Entomologist. (Host and oviposition attractant, Calvin M. Jones).

Effective attractants are desperately needed for use in population surveys or as supplemental controls. We do not have a bait better than decomposing liver. Liver attracts only the female screwworm flies in addition to huge numbers of ordinary blow flies. This makes it impractical to monitor eradication progress with liver traps. Therefore, this position involves the evaluation of chemical, physical, or microbial factors associated with the wounds of animals which may be responsible for the attraction of screwworm flies to their hosts for feeding and/or oviposition.

Engineer. (John L. Goodenough). Much engineering expertise is needed in the improvement of procedures related to rearing, fly distribution and trapping. Of immediate concern is the development of equipment to remove waste products in larval rearing, separation of larvae and pupae, and the improvement of packaging and distribution equipment. Physical attractants (sound) will occupy a considerable portion of the engineer's time in addition to providing leadership in the design of traps as attraction mechanisms are found.

Nutrition Chemist. (Harold E. Brown). Dr. Brown is currently on loan from Weslaco. The chief need is in developing new or improved diets for screwworm production. The current hydroponic diet is a candidate

separated. In addition, physiological studies involving digestion, and
 sensory systems are needed to support nutritional studies and develop
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 for screwworm production. The current hydroponic diet is a candidate

cause for recent program problems. In addition, the finding of new protein sources as well as developing methods to reclaim or recycle unused proteins of the diet is important.

Additional SMY's Needed

Geneticist. This area presents a special problem for our research effort. The immediate problem is to determine the best method for introduction of genetic material into the Mission stock to insure the best interim results. At the same time, standards must be developed to insure continuous quality of reared insects. This individual must work with the Mexico ecologist to study the possibility of subpopulations or biotypes in Mexico and determine how to maintain insects suitable for the diverse terrain and weather situations of Mexico (one strain for all areas or special strains for special areas, etc.).

Entomologist. (rearing and physiology). This individual will handle the actual incorporation of genetic material into the factory strain and develop procedures to prevent factory adaptation of fly strains while retaining characteristics for good production. In addition, this individual will conduct isoenzymes studies to determine their use as monitors for laboratory population. The same technique will be used to determine the existence of biotypes (in cooperation with the geneticist and ecologist).

Ecologist. (Two). To study the biology and ecology of the screwworm. The number one priority in this research is to understand the total concept

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Ecologist. (Two). To study the biology and ecology of the screwworm. The number one priority in this research is to understand the total concept

of the sterile male technique as it relates to the screwworm so that the causes for recent outbreaks in the United States can be determined. Life tables will result from this work. Program effectiveness will also be evaluated by the ecologists. They will evaluate the strains for mass rearing as well as other variables before they become integrated into the program.

Entomologist. (Sex attraction and mating behavior). No effort is now being made to use sex attractants as a survey tool, and screwworm mating has never been observed in nature. This area has been long neglected and needs a full-time commitment. Sex attraction offers a method of survey as well as supplemental control. Knowledge of mating habits and behavior can be critical in the eventual success of the program.

Chemist. To direct chemical aspects of research directed toward the isolation, identification, and synthesis of host sex, oviposition, or aggregate attractants. This work is essential in cooperation with the 2 entomologists and engineer to complete the team approach in developing survey and alternate control procedures.

Entomologist. (Gulf Coast Tick). In the last few years, the Gulf Coast Tick has increased in abundance throughout South Texas. The net result has been an increase in wounds for screwworm infestation. Ticks have been cited as the principal cause of the 1973 outbreak. The situation appears similar for 1974. Little is known about the biology and control

of the sterile male technique as it relates to the screwworm so that the
causes for recent outbreaks in the United States can be determined. Life
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To: M. T. Ouye & L. Henderson

as it relates to the screwworm. Research effort is needed to provide the information necessary to control this pest. In addition, no research is currently under way to develop alternate and improved methods of screwworm control to supplement the sterile male technique.

FROM: E. A. TAYLOR, WesLaco Tx

Note: 7 pages were transmitted
Friday afternoon. This
Transmittal is 7 pages.

To: M. T. Owe & L. Henderson

8

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FROM: E. A. TAYLOR, Westaco TX

Note: 7 pages were transmitted
Friday afternoon. This
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Tabular Summary of Current Personnel

Position	Grade	Title or Responsibility
J. W. Snow	14	Research Leader
M. M. Crystal	14	Radiation Biology
H. E. Brown	13	Nutrition Chemist
J. L. Goodenough	12	Engineer
B. G. Hightower	12	Ecologist
C. M. Jones	12	Entomologist (Host & Oviposition Attractant)
J. P. Turner	7	Biological Technician
E. Lopez	7	Biological Technician
F. Gonzalez	7	Agricultural Research Technician
B. Handke	5	Biological Technician
J. J. Garcia	5	Biological Aid
T. Jester	4	Clerk Typist
B. Anthony	3	Biological Aid
A. Fuentes	3	Biological Aid

1/ Includes 3 scientists for Mexico.

Amount needed to support current staff (\$65,000/SMY)	\$390,000
Current Funding	<u>343,985</u>
Deficit	\$ 46,015

Tabular Summary of Current Personnel

Position	Grade	Title or Responsibility
J. W. Snow	14	Research Leader
M. M. Crystal	14	Radiation Biology
R. E. Brown	13	Nutrition Chemist
J. L. Goodenough	13	Engineer
D. G. Hightower	13	Ecologist
C. M. Jones	13	Entomologist (Host & Oviposition Assistant)
J. P. Turner	7	Biological Technician
E. Lopez	7	Biological Technician
F. Gonzalez	7	Agricultural Research Technician
D. Handke	5	Biological Technician
J. J. Garcia	5	Biological Aid
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A. Fuentes	3	Biological Aid

1/ Includes 3 scientists for Mexico.

Belice
 Current Funding
 Amount needed to support current staff (\$25,000/3MY)
 \$330,000
 \$43,982
 \$ 86,018

Tabular Summary for New Personnel

Position	Grade	Title or Responsibility
Vacancy	12	Geneticist
Vacancy	12	Physiology-production
Vacancy	12	Chemist
Vacancy	11	Ecologist
Vacancy	11	Ecologist
Vacancy	11	Entomologist (Sex attraction)
Vacancy	11	Entomologist (Ticks)

Additional Technical Help

1	GS 7	Technician
3	GS 5	Technician
3	GS 3	Technician
1	WG 2	Laborer
1	GS 3	Clerk-typist

Amount needed to support expansion (\$65,000/SMY) \$455,000

Tabular Summary for New Personnel

Position	Grade	Title or Responsibility
Vacancy	12	Geneticist
Vacancy	12	Physiology-production
Vacancy	12	Chemist
Vacancy	11	Ecologist
Vacancy	11	Ecologist
Vacancy	11	Entomologist (Sex attraction)
Vacancy	11	Entomologist (Ticks)
<u>Additional Technical Help</u>		
1. Geneticist	GS 7	Technician
3. Technician	GS 5	Technician
3. Technician	GS 3	Technician
1. Laborer	WG 2	Laborer
1. Clerk-typist	GS 3	Clerk-typist

Amount needed to support expansion (\$65,000/2MY) \$425,000

The total direct appropriation needed to support 13 scientists is \$845,000 (\$65,000/SMY). Currently Mission has 6 scientists and \$291,700 at project level. In addition, this estimate shows cost for 3 scientists scheduled for expansion to Mexico. Costs involved in establishing facilities in Mexico are not included. The expansion of personnel from Mission to Mexico is advantageous in that the best qualified personnel from our laboratory may be transferred. In addition, new scientists can gain screwworm experience and establish the basis for later cooperation.

Field Cage.

A field cage is needed in South Texas to conduct experiments as follows:

- a. Conduct tests to determine if assortive mating is occurring in the field. The determination of this phenomenon, if it exists, can be established and solutions found only through the use of a cage or similar device.
- b. Evaluate competitiveness of laboratory production flies against wild fly populations. In addition, effects of radiation, cold, heat, etc., on competitiveness will be evaluated.
- c. Conduct biological studies of the life cycle, circadian rhythms, host relationship, winter survival, etc.
- d. Develop and test traps designed to capture adults based on sex, sound, or host.

The total direct appropriation needed to support 13 scientists is \$242,000 (\$65,000/2NY). Currently Mission has 6 scientists and \$191,700 at project level. In addition, this estimate shows cost for 3 scientists scheduled for expansion to Mexico. Costs involved in establishing facilities in Mexico are not included. The expansion of personnel from Mission to Mexico is advantageous in that the best qualified personnel from our laboratory may be transferred. In addition, new scientists can gain experience and establish the basis for later cooperation.

Field Cages.

A field cage is needed in South Texas to conduct experiments as

follows:

- a. Conduct tests to determine if associative mating is occurring in the field. The determination of this phenomenon, if it exists, can be established and solutions found only through the use of a cage or similar device.
- b. Evaluate competitiveness of laboratory production flies against wild fly populations. In addition, effects of radiation, cold, heat, etc., on competitiveness will be evaluated.
- c. Conduct biological studies of the life cycle, circadian rhythms, host relationship, winter survival, etc.
- d. Develop and test traps designed to capture adults based on sex, sound, or host.

Need for Construction. Field tests to evaluate new strains or determine the effects of various procedures on fly performance are difficult and inaccurate. Usually many square miles, millions of adults, airplanes, pilots, and large ground truth teams are involved. A cage of sufficient size to permit normal fly activity will eliminate most field tests and greatly improve the overall research effort. Observations of screwworm behavior in nature are rare because of their sparse distribution. Cage observations will serve as the basis to obtain clues on mating sites, behavior, host finding, etc. The much talked about possibility of assortive mating can be established and defined only through the use of cages or similar methods.

Plan of Work. The facilities should be constructed at Weslaco, Texas, to escape the odors and high factory release population at Moore Air Base. Weslaco provides protected Federal property, year round availability, easy access and security control from Mission. In addition, the structure can be used for other research purposes once the screwworm needs are completed. The cage is probably the most needed research tool to insure adequate data in support of the screwworm eradication program.

Cost. Approximately \$296,000 (plans attached).

Funds for Cooperative Work.

Currently ARS has cooperative agreements with several US and Mexican agencies to provide outside support to screwworm research. Among these are:

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Cost. Approximately \$250,000 (plans attached).

Funds for Cooperative Work.

Currently ARS has cooperative agreements with several US and Mexican agencies to provide outside support to screwworm research. Among these

- a. Instituto Nacional de Investigaciones Agricolas
- b. University of Texas
- c. Texas A&M University
- d. National Aeronautics and Space Administration
- e. Instituto Tecnologico de Monterrey

Recently, the Attractants Laboratory, Gainesville, Florida, and the radiation Laboratory, Fargo, North Dakota, have shown great interest in screwworm research. Research conducted by outside institutions is of particular importance in rounding out the Mission program. Scientists with specialized expertise can thus be involved in the program through this method. Mission needs \$200,000/year to continue to support this work.

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Summary of Budget and SMY Needs on a Recurring Basis

<u>1/</u> Item	Unit
Current SMY's	6
Current Funding	\$343,985
Needed Funding (\$65,000/SMY)	\$390,000
Increase Needed	\$ 46,015

Expansion

Needed SMY's	7
Needed Funding (\$65,000/SMY)	\$455,000
Funds for Cooperative Agreements	\$200,000

Total Budget \$1,045,000 for 13 SMY's in the US and Mexico.

1/ A construction item for \$296,000 is needed for the first year to construct a field cage.

Summary of Budget and SMI Needs on a Recurring Basis

Item	Unit
Current SMI's	6
Current Funding	\$343,982
Needed Funding (\$25,000/SMI)	\$390,000
Increase Needed	\$ 46,018
<u>Expansion</u>	
Needed SMI's	7
Needed Funding (\$25,000/SMI)	\$425,000
Funds for Cooperative Agreements	\$200,000

Total Budget \$1,042,000 for 13 SMI's in the US and Mexico.

1/ A construction item for \$296,000 is needed for the first year to

construct a field cage.

CURRENT MISSION RESEARCH STATUS AND REQUIRED CHANGES TO MEET RESEARCH
NEEDS FOR THE EXPANDED SCREWORM ERADICATION PROGRAM

History of Program.

From 1962 to 1971 (with a minor exception in 1968), the screwworm eradication program successfully controlled screwworms in the United States. During this time, the ARS Research Laboratory was established (1963) at Mission with a budget of \$200,000/year. However, these funds were allocated through the Kerrville Laboratory and passed to Mission based on numbers of SMY's rather than appropriated funds. During this period, many professionals transferred or retired without replacement. From a maximum of 6 staff members in 1963, only 3 remained committed to screwworm research by 1972.

During 1972, the program suffered a serious setback in the southwestern states. A total of 96,625 cases were reported in Texas alone. There were undoubtedly more unreported cases. During this year, the United States signed an agreement with Mexico to extend the eradication program to the Isthmus of Tehuantepec.

During 1973, the situation was again serious in South Texas. Some ranchers reported as much as 30% loss of herds. Effective control was not obtained until late season as a result of adverse weather. This outbreak was related to high populations of the Gulf^f Coast Tick that provided large numbers of wounds. In 1974 the situation through June indicates another bad year. Infestations are currently 3 times greater than 1973 and range throughout most of Texas. Gulf Coast Ticks are becoming common in South Texas.

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Therefore, ^{it} ~~the fact~~ becomes apparent that the screwworm program has been extended to include Mexico at a time when results suggest that serious problems exist in our current program. The Agricultural Research Service recognized this after the 1972 outbreak and began restaffing the laboratory and transferring support funds. Currently, 5 SMY's are at Mission with a chemist on loan from Crops Research, Weslaco, Texas. The current ^{approved} proposed budget for FY 75 is \$291,700, ^{at present level.} The additions have been made through reallocation of existing personnel and funds. The APHIS budget for Mexico and the United States will range from 16 to 20 million/year. Based on current problems and the expanded program, ARS will not be able to adequately meet the research needs of the APHIS program. A proposal is currently before Congress to increase the Mission budget by \$202,000/year ^(appropriation level) ~~(minus 15.2%)~~ and provide 3 additional SMY's.

Potential Causes of Reduced Program Effectiveness.

The highest research priority is the identification of the ~~fact or~~ factors involved in the recent ineffectiveness of release flies. Candidate reasons are:

1. Nutrition. The factory converted to a hydroponic diet shortly before the first outbreak in 1972. This diet has been used ^{intermittently} since that time. Sufficient data are not available to establish this medium as a good substitute for meat.
2. Assortive Mating. The selection of an avoidance or recognition mechanism by wild flies over the last 12 years (resistance).

Therefore, the fact becomes apparent that the screwworm program

has been extended to include Mexico at a time when results suggest

that serious problems exist in our current program. The Agricultural

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2 SMT's are at Mission with a chemist on loan from Crops Research,

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mechanism by wild flies over the last 12 years (resistance).

3. Behavioral Isolation. Undetected changes in rearing and handling procedures that resulted in alteration of behavior sufficient to isolate the released population (preferential mating of factory x factory flies).

4. Laboratory Adaptation of Strains. Factory strains may lose the ability to compete in the field through natural selection in the process of becoming adapted to factory production.

5. Remating. Factory males may no longer be able to satisfy the wild females in copulation. Equally possible is the ^election of wild fly populations that ^{accept multiple matings} ~~mate~~ multiply.

6. Ticks. Increase screwworm cases resulting from an increase in number of wounds caused by the Gulf Coast Tick.

7. Quality Control. Inadequate control of quality in the rearing, packaging, or distribution phase that results in the release of non-competitive insects.

8. Weather. Favorable weather which results in excessive survival of screwworm populations during the winter months.

9. Changes in Practices. Ranchers have changed their practices with the result of ^{that cattle population has increased} ~~more cattle~~, uncontrolled calving, absence of sufficient cowboys, etc.

While we must investigate all the above factors, our commitment for new research and improved procedures continues. Population detection methods are desperately needed for survey and evaluation. Additional control components are needed as the program moves into Mexico. The Mexico program demands more ecological data regarding distribution,

3. Behavioral Isolation. Undetected changes in rearing and handling procedures that resulted in alteration of behavior sufficient to isolate the released population (preferential mating of factory flies).

4. Laboratory Adaptation of Strains. Factory strains may lose the ability to compete in the field through natural selection in the process of becoming adapted to factory production.

5. Remating. Factory males may no longer be able to satisfy the wild females in copulation. Equally possible is the selection of wild fly populations that mate readily.

6. Ticks. Increase screwworm cases resulting from an increase in number of wounds caused by the Gulf Coast Tick.

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While we must investigate all the above factors, our commitment for new research and improved procedures continues. Population detection methods are desperately needed for survey and evaluation. Additional control components are needed as the program moves into Mexico. The Mexico program demands more ecological data regarding distribution,

abundance and overwintering. Strong possibilities exist that biotypes of the species ^{occur} in the diverse terrain of Mexico.

Current SMY's at Mission.

Research Leader (J. Wendell Snow). Coordinates research and cooperative agreements (Texas A&M, University of Texas, INIA, Monterrey Tech) into the screwworm eradication program with both APHIS and the Joint Screwworm Commission. In addition, original research will be conducted by the Research Leader in the areas of ecology, attraction, and competitiveness.

Ecologist^{1/} (Billie G. Hightower--to transfer in August). Provides field research on the species in diverse ^{Mexican locations} ~~situations~~ of Mexico. All the varied factors encountered in production and distribution of 200 million sterile flies per week plus an additional 300 million weekly when the plant in Mexico is activated must be recognized and evaluated. Behavior of wild flies in canyons and mountain saddles is of particular importance. The existence of biotypes or even distinct species in Mexico must be ^{determined} ~~studied~~.

Radiation. (Maxwell M. Crystal). The effects of radiation on competitiveness and development of improved methods of sterilization are of principal importance. The effects of radiation on competitiveness is a candidate cause of current program problems. The development of chemical markers such as Calco Red, Rubidium, etc., that are compatible with factory production ^{should be developed} ~~will also be studied~~. Currently the factory and

1/ High priority position--needs to be filled desperately.

abundance and overwintering. Strong possibilities exist that biotypes of the species in the diverse terrain of Mexico.

Current ERM's at Mission.

Research Leader (J. Wendell Snow). Coordinates research and cooperative agreements (Texas A&M, University of Texas, INIA, Monterrey Tech) into the screwworm eradication program with both AEMIS and the Joint Screwworm Commission. In addition, original research will be conducted by the Research Leader in the areas of ecology, attraction, and competitiveness.

Ecologist (Billie G. Hightower--to transfer in August). Provides field research on the species in diverse altitudes of Mexico. All the varied factors encountered in production and distribution of 200 million sterile flies per week plus an additional 300 million weekly when the plant in Mexico is activated must be recognized and evaluated. Behavior of wild flies in canyons and mountain saddles is of particular importance. The existence of biotypes or even distinct species in Mexico must be established.

Radiation (Maxwell M. Gypsy). The effects of radiation on competitiveness and development of improved methods of sterilization are of principal importance. The effects of radiation on competitiveness is a candidate cause of current program problems. The development of chemical markers such as Galio Red, Rubidium, etc., that are compatible with factory production will also be studied. Currently the factory and

I/ High priority position--needs to be filled desperately.

wild flies cannot be effectively separated. In addition, physiological studies involving digestion, and enzyme systems are needed to support nutritional studies and develop standard laboratory evaluation systems for performance.

Entomologist (Host and oviposition attractant, Calvin M. Jones).

Effective attractants are desperately needed for use in population surveys or as supplemental controls. We do not have a bait better than decomposing liver. Liver only attracts ^{the} female screwworms ^{flies} in addition to huge numbers of ordinary blow flies. This ~~fact alone~~ makes it impractical to monitor eradication progress with liver traps. Therefore, this position involves the evaluation of chemical, physical, or microbial factors associated with the wounds of animals which may be responsible for the attraction of screwworm flies to their hosts for feeding and/or oviposition.

Engineer. (John L. Goodenough) Much engineering expertise is needed in the improvement of procedures related to rearing, fly distribution and trapping. Of immediate concern is the development of equipment to remove waste products in larval rearing, separation of larvae and pupae, and the improvement of packaging and distribution equipment. Physical attractants (sound) will occupy a considerable portion of the engineer's time in addition to providing leadership in the design of traps as attraction mechanisms are found.

Nutrition Chemist (Harold E. Brown). Dr. Brown is currently on loan from Weslaco, and ~~hopefully will remain with our program.~~ The chief need

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Nutrition Chemist (Harold E. Brown). Dr. Brown is currently on loan

from Weslaco and hopefully will remain with our program. The chief need

is in developing new or improved diets for screwworm production. The current hydroponic diet is a candidate cause for recent program problems. In addition, the finding of new protein sources as well as developing methods to reclaim or recycle unused proteins of the diet is important.

Additional SMY's Needed.

Geneticist. This area presents a special problem for our research effort. The immediate problem is to determine the best method for introduction of genetic material into the Mission stock to insure the best interim results. At the same time, standards must be developed to insure continuous quality of reared insects. This individual must work with the Mexico ecologist to study the possibility of subpopulations or biotypes in Mexico and determine how to maintain insects suitable for the diverse terrain and weather situations of Mexico (one strain for all areas or special strains for special areas, etc.).

Entomologist (rearing and physiology). This individual will handle the actual incorporation of genetic material into the factory strain and develop procedures to prevent factory adaptation of fly strains while retaining characteristics for good production. In addition, this individual will conduct isoenzymes studies to determine their use as monitors for laboratory population. The same technique will be used to determine the existence of biotypes (in cooperation with the geneticist and ecologist).

Ecologist (Two). To study the biology and ecology of the screwworm. ~~as it relates to the sterile male technique in the United States. The~~

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Ecologist (Two). To study the biology and ecology of the screwworm.

as it relates to the sterile male technique in the United States. The

~~number one priority in this research is to understand the total concept as it relates to the sterile male technique in the United States. The~~

~~number one priority in this research is to understand the total concept~~

as it relates to the screwworm so that the causes for recent outbreaks

can be determined. Life tables will result from this work. Program

effectiveness will also be evaluated by the ecologists. They will

evaluate the final selection of strains for mass rearing as well as

other variables before they become integrated into the program.

Entomologist (Sex attraction and mating behavior). No effort is now being made to use sex attractions ^{ants} as a survey tool, and screwworm mating has never been observed in nature. This area has been long neglected and needs a full-time commitment. Sex attraction offers a method of survey as well as supplemental control. Knowledge of mating habits and behavior can be critical in the eventual success of the program.

Chemist. To direct chemical aspects of research directed toward the isolation, identification, and synthesis of host sex, oviposition, or aggregate attractants. This work is essential in cooperation with the 2 entomologists and engineer to complete the team approach in developing survey and alternate control procedures.

Entomologist (Gulf Coast Tick). In the last few years, the Gulf Coast Tick has increased in abundance throughout South Texas. The net result has been an increase in wounds for screwworm attack. Ticks have been cited as the principal cause of the 1973 outbreak. The situation

...one priority ... to understand the ...
... to the ...

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appears similar for 1974. Little is known about the biology and control as it relates to the screwworm. Research effort is needed to provide the information necessary to control this pest. In addition, no research is currently under way to develop ^{alternate} new and improved methods of screwworm control. *to supplement the sterile male technique.*

appears similar for 1974. Little is known about the biology and control

as it relates to the screwworm. Research effort is needed to provide

the information necessary to control this pest. In addition, no research

is currently under way to develop new and improved methods of screwworm

control. The following are the major areas of research that need to be

addressed: (1) the biology and life history of the screwworm; (2) the

ecology of the screwworm; (3) the host-parasite relationship; (4) the

control of the screwworm; (5) the development of new control methods; (6)

the development of new control methods; (7) the development of new control

methods; (8) the development of new control methods; (9) the development of

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methods; (27) the development of new control methods; (28) the development

of new control methods; (29) the development of new control methods; (30)

the development of new control methods; (31) the development of new control

Tabular Summary of Current Personnel

Position	Grade	Title or Responsibility
J. W. Snow	14	Research Leader
M. M. Crystal	14	Radiation Biology
H. E. Brown	13	Nutrition Chemist
J. L. Goodenough	12	Engineer
B. G. Hightower	12	Ecologist
C. M. Jones	12	Entomologist (Host & oviposition Attractant)
J. P. Turner	7	Biological Technician
E. Lopez	7	Biological Technician
F. Gonzalez	7	Agricultural Research Technician
B. Handke	5	Biological Technician
J. J. Garcia	5	Biological Aid
T. Jester	4	Clerk Typist
H. Bazan	4	Biological Aid
B. Anthony	3	Biological Aid
A. Fuentes	3	Biological Aid

1/ Includes 3 scientists for Mexico.

Amount needed to support current staff (\$65,000/SMY)	\$390,000
Current Funding	343,985 291,700
Deficit:	98,300 46,015

Tabular Summary of Current Personnel

Position	Grade	Title or Responsibility
J. W. Snow	1A	Research Leader
M. M. Crystal	1A	Radiation Biology
H. E. Brown	1B	Nutrition Chemist
J. L. Goodenough	1B	Engineer
E. G. Highower	1B	Ecologist
C. M. Jones	1B	Entomologist (Host & oviposition Attractant)
J. P. Turner	7	Biological Technician
E. Lopez	7	Biological Technician
F. Gonzalez	7	Agricultural Research Technician
B. Hendke	5	Biological Technician
J. J. Garcia	5	Biological Aid
T. Jester	4	Clark Typist
H. Raman	4	Biological Aid
B. Anthony	3	Biological Aid
A. Fuentes	3	Biological Aid

I \ Includes 3 scientists for Mexico.

\$350,000

Amount needed to support current staff (\$65000/25%)

281,750

Current Funding

68,250

Deficit

213,500

Tabular Summary for New Personnel

Position	Grade	Title or Responsibility
Vacancy	12	Geneticist
Vacancy	12	Physiology-production
Vacancy	12	Chemist
Vacancy	11	Ecologist
Vacancy	11	Ecologist
Vacancy	11	Entomologist (Sex attraction)
Vacancy	11	Entomologist (Ticks)

Additional Technical Help

1	GS 7	Technician
3	GS 5	Technician
3	GS 3	Technician
1	WG 2	Laborer
1	GS 3	Clerk-typist

Amount needed to support expansion $(65,000/\text{year})$ ^{455,000} ~~\$450,000~~

Tabular Summary for New Personnel

Position	Grade	Title or Responsibility
Vacancy	12	Geneticist
Vacancy	12	Physiology-production
Vacancy	12	Chemist
Vacancy	11	Ecologist
Vacancy	11	Ecologist
Vacancy	11	Entomologist (Sex attraction)
Vacancy	11	Entomologist (Ticks)
<u>Additional Technical Help</u>		
1	GS 7	Technician
3	GS 2	Technician
3	GS 3	Technician
1	WG 2	Laborer
1	GS 3	Clerk-typist

Amount needed to support expansion (6500/2m) \$450,000

The total direct appropriation needed to support 13 scientists is \$845,000 (\$65,000/SMY). Currently Mission has 6 scientists and \$291,700/ ^{at project level.} In addition, this estimate shows cost for 3 scientists scheduled for expansion to Mexico. Costs involved in establishing facilities in Mexico are not included. The expansion of personnel from Mission to Mexico is advantageous in that the best qualified personnel from our laboratory ^{may} ~~can~~ be transferred. In addition, new scientists can gain screwworm experience and establish the basis for later cooperation.

Field Cage.

A field cage is needed in South Texas to conduct experiments as follows:

- a. Conduct tests to determine if assortive mating is occurring in the field. The determination of this phenomenon, if it exists, can be established and solutions found only through the use of a cage or similar device.
- b. Evaluate competitiveness of laboratory production flies against wild fly populations. In addition, ~~comparisons involving the~~ effects of radiation, cold, heat, etc., on competitiveness will be evaluated.
- c. Conduct biological studies of the life cycle, circadian rhythms, host relationship, winter survival, etc.
- d. Develop and test traps designed to capture adults based on sex, sound, or host.

The total direct appropriation needed to support 13 scientists is \$865,000 (\$65,000/300). Currently Mission has 6 scientists and \$291,700. In addition, this estimate shows cost for 3 scientists scheduled for expansion to Mexico. Costs involved in establishing facilities in Mexico are not included. The expansion of personnel from Mission to Mexico is advantageous in that the best qualified personnel from our laboratory can be transferred. In addition, new scientists can gain experience and establish the basis for later cooperation.

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- a. Conduct tests to determine if associative mating is occurring in the field. The determination of this phenomenon, if it exists, can be established and solutions found only through the use of a cage or similar device.
- b. Evaluate competitiveness of laboratory production flies against wild fly populations. In addition, ~~competitive~~ ^{competitive} effects of radiation, cold, heat, etc., on competitiveness will be evaluated.
- c. Conduct biological studies of the life cycle, circadian rhythms, host relationship, winter survival, etc.
- d. Develop and test traps designed to capture adults based on sex, sound, or host.

Need for Construction. Field tests to evaluate new strains or determine the effects of various procedures on fly performance are difficult and inaccurate. Usually many square miles, millions of adults, airplanes, pilots and large ground truth teams are involved. A cage of sufficient size to permit normal fly activity will eliminate most field tests and greatly improve the overall research effort. Observations of screwworm behavior in nature are rare because of their sparse distribution. Cage observations will serve as the basis to obtain clues on mating sites, behavior, host finding, etc. The much talked about possibility of assortive mating can be established and defined only through the use of cages or similar methods.

Plan of Work. The facilities should be constructed at Weslaco, Texas, to escape the odors and high factory release population at Moore Air Base. Weslaco provides protected Federal property, year round availability, easy access and security control from Mission. In addition, the structure can be used for other research purposes once the screwworm needs are completed. The cage is probably the most needed research tool to insure adequate data in support of the screwworm eradication program.

Cost. Approximately \$296,000 (plans attached).

Funds for Cooperative Work.

Currently ARS has cooperative agreements with several US and Mexican agencies. to provide outside support to screwworm research. Among these are:

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Cost. Approximately \$100,000 (plans attached).

Funds for Cooperative Work.

Currently ARS has cooperative agreements with several US and Mexican

agencies to provide outside support to screwworm research. Among these

are:

- a. Instituto Nacional de Investigaciones Agricolas
- b. University of Texas
- c. Texas A&M
- d. NASA
- e. Instituto Tecnologico de Monterrey

Recently, the Attractants Laboratory, Gainesville, Florida, and the radiation Laboratory, Fargo, North Dakota, have shown great interest in screwworm research. Research conducted by outside institutions is of particular importance in rounding out the Mission program. Scientists with specialized expertise can thus be involved in the program through this method. Mission needs \$200,000/year to continue to support this work.

Summary of Budget and SMY Needs on a Recurring Basis.

<u>Item</u> ^{1/}	<u>Unit</u>
Current SMY's	6
Current Funding	\$291,700
Needed Funding (\$65,000/SMY)	\$390,000
Increase Needed	\$ ^{46,015} 98,300

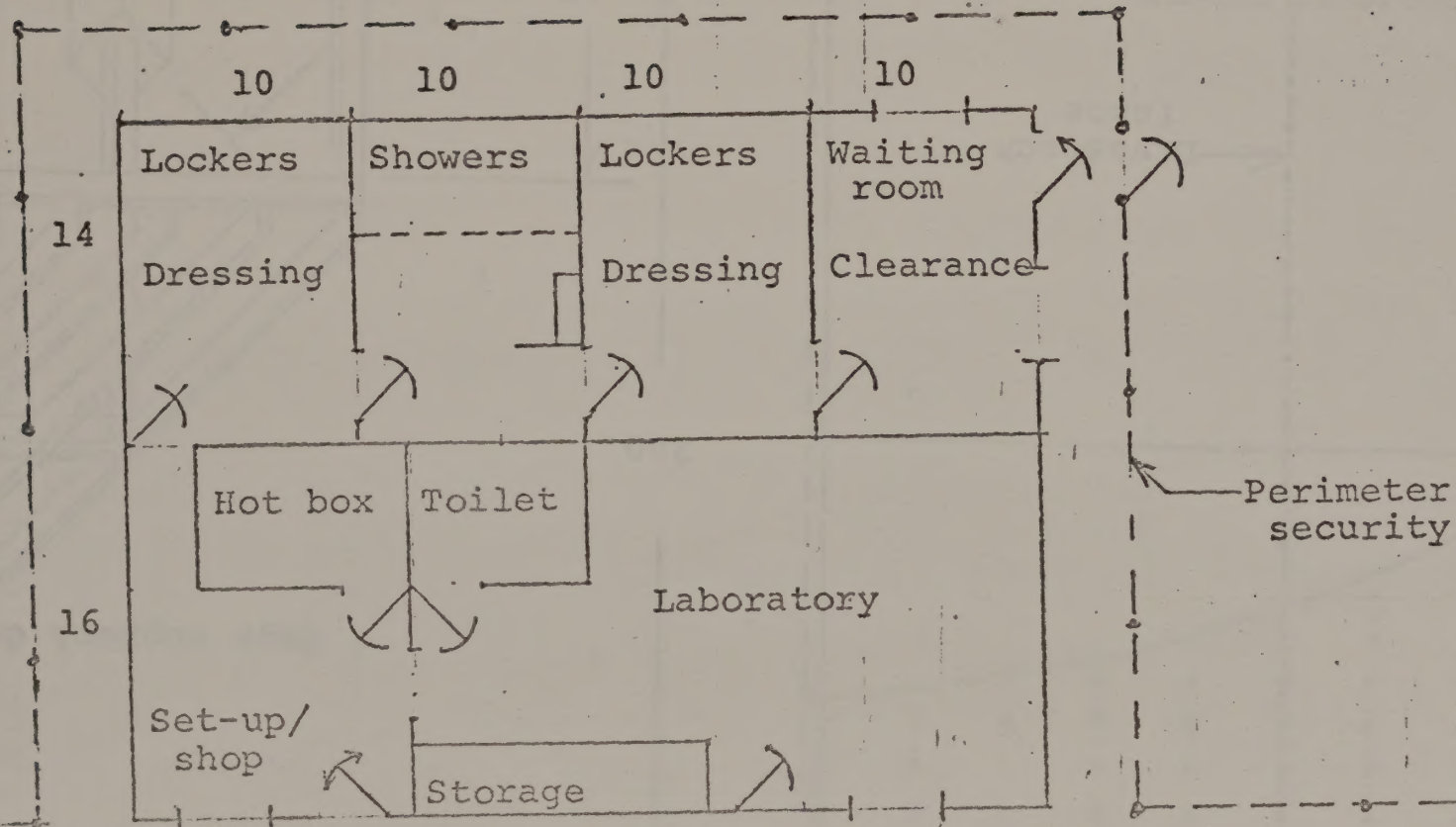
Expansion

Needed SMY's	7
Needing Funding (\$65,000/SMY)	\$45 ⁵ 0 ,000
Funds for Cooperative Agreements	\$200,000

Total Budget \$1,040,000⁵ for 13 SMY's in the US and Mexico.

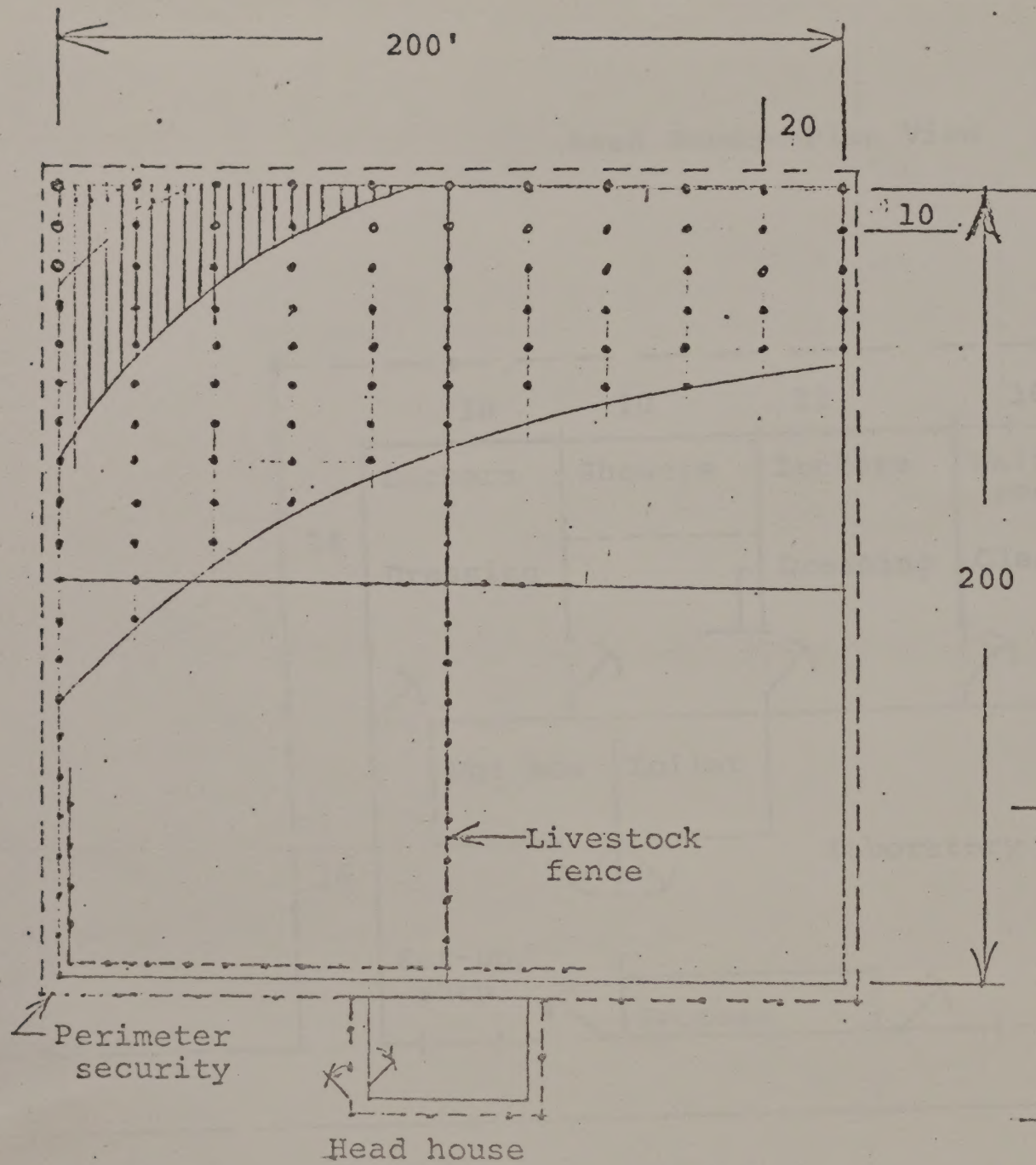
1/ A construction item for \$296,000 is needed for the first year to construct a field cage.

Head House--Plan View

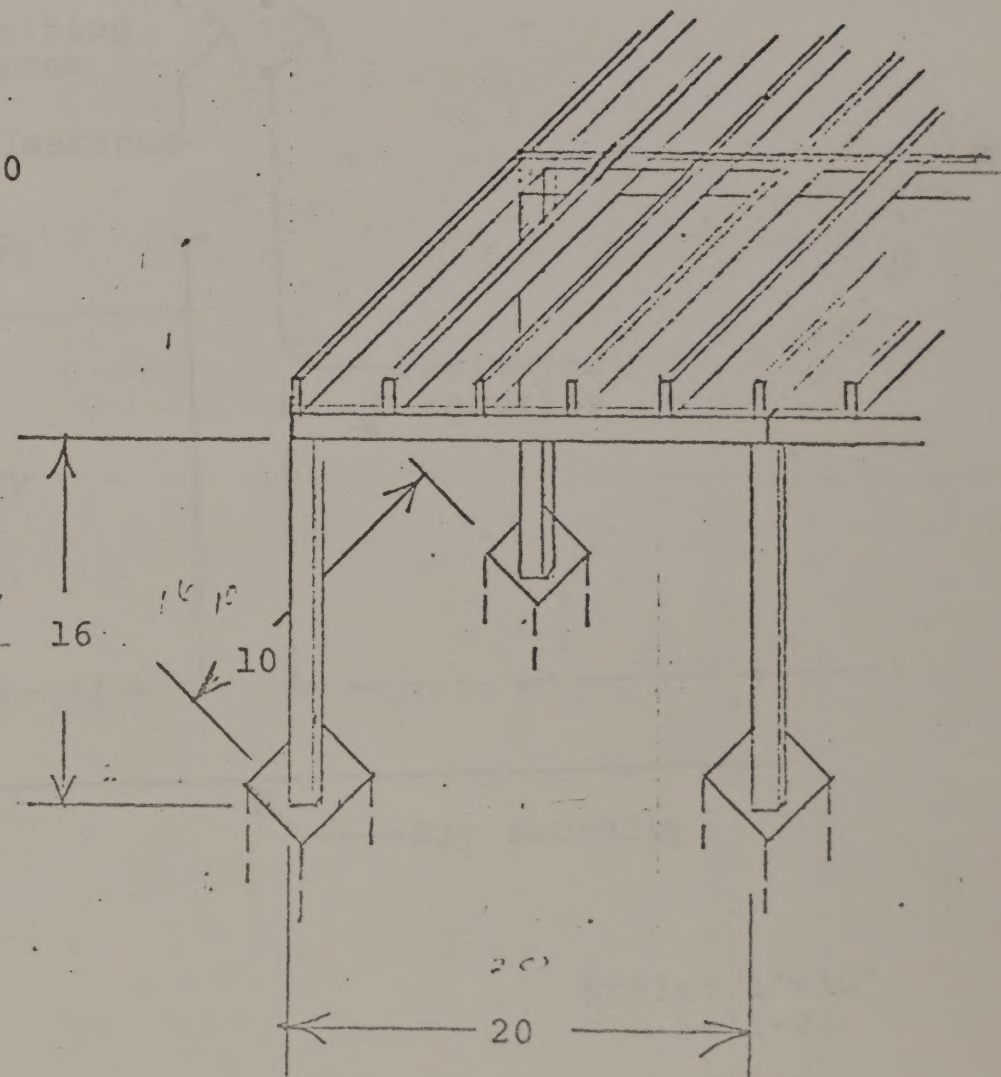


Scale: 1"=10'
JLG 5-11-74

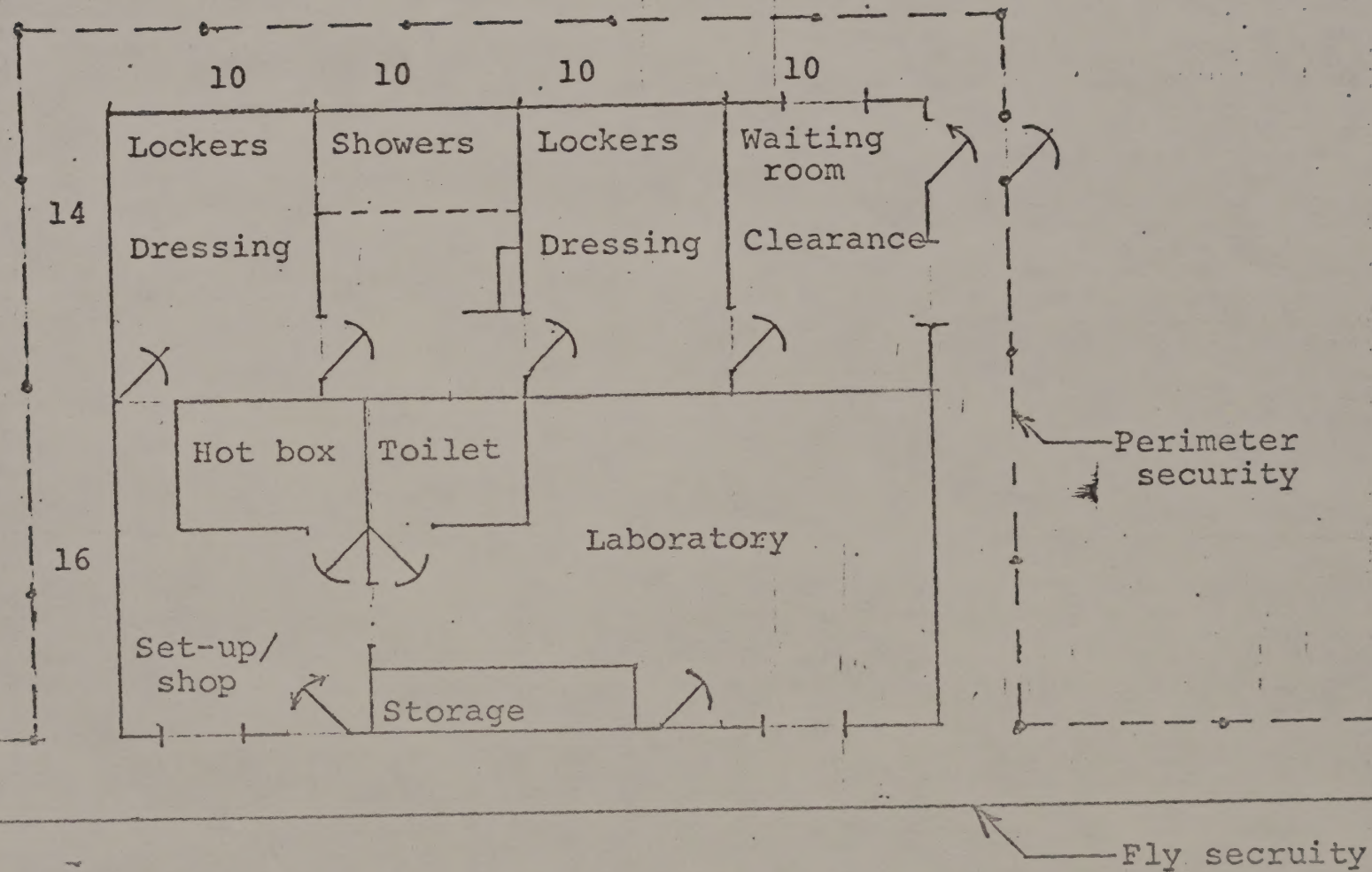
Fly Cage--Plan View



Cage support detail



Head House--Plan View



100 2-7-14
2010 1-1-14



Hand Drawn - 1/14/14